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A COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM FOR THE MISSISSIPPI-DES MOINES-SKUNK RIVERS BASIN DEVELOPED BY THE STATE WATER POLLUTION CONTROL AGENCIES OF ILLINOIS, IOWA, MINNESOTA, AND MISSOURI

Public Health Service
Cincinnati, Ohio

1953

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Water Pollution Series No. 55

A COMPREHENSIVE PROGRAM FOR WATER POLLUTION CONTROL

for the

Mississippi-Des Moines-Skunk Rivers Basin

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A COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM

for the

Mississippi-Des Moines-Skunk Rivers Basin

Developed by the State Water Pollution Control Agencies
of
ILLINOIS, IOWA, MINNESOTA, and MISSOURI

1953

Adopted by

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service

I

FOREWORD

Our country's development over the past 50 years has been marked by tremendous progress in many fields. It has made possible great gains in the health, comfort, and well-being of the people. But it has not been without cost. Part of the cost has been the damage to the Nation's water resources that has resulted from wastes discharged to the streams by our growing cities and industries. All water uses have been affected--public water supplies, recreation, agriculture, industry, fish and aquatic life.

In enacting the Federal Water Pollution Control Act in 1948, the Congress declared that "water pollution has become a matter of grave concern in many areas and its damaging effects on the public health and national resources are a matter of definite Federal concern as a menace to national welfare. Abatement must be undertaken in order to control it."

The Public Health Service, as part of its responsibilities under this Act, is required to prepare or adopt, in cooperation with other Federal agencies, State and interstate water pollution control agencies, and municipalities and industries, comprehensive programs for the abatement of pollution.

This report contains the comprehensive water pollution control program for the Mississippi-Des Moines-Skunk Rivers Basin of the Iowa State Department of Health, Illinois Sanitary Water Board, Minnesota State Department of Health, and the Missouri Division of Health. The program is sound and gives full consideration to the several present uses and to the reasonably anticipated future uses of the waters of this basin. It provides an equitable balance in the pollution control requirements for various private and public groups concerned.

I am pleased, therefore, in my capacity as Surgeon General of the Public Health Service, to adopt the program developed by the State water pollution control agencies of Iowa, Illinois, Minnesota, and Missouri for the Mississippi-Des Moines-Skunk Rivers Basin as a comprehensive program which fully meets the requirements of the Federal Water Pollution Control Act.

This program is based on beneficial water uses and related conditions that prevailed on January 1, 1953. Comprehensive programs for pollution control must necessarily be flexible. They must allow for growth, development, and changing conditions. Any significant changes affecting water quality, such as stream flow, water use, industrial development, population, etc., may require changes in the pollution control program.

Obviously the mere adoption of this program will not, in itself, reduce pollution or improve the usefulness of the waters in this basin. It does provide to the citizens of the area and to the city officials and industrial leaders, farmers, fishermen, conservationists, and others an objective plan based on good engineering practice, and reflecting sound economics. It is a plan which the public can support, and must support, if progress is to be made in the abatement of pollution.

Certain additional considerations beyond the mere acceptance of a plan are essential to its successful execution. The citizens of the areas affected must see that sufficient resources are provided to the State water pollution control agencies concerned to enable them to make the technical investigations to aid those responsible for constructing pollution abatement works.

We must recognize, too, that in order to be fully effective the plans and programs of one State must be geared closely to those of adjoining States, since State boundaries are no barrier to pollution traveling in interstate streams. Above all, no program of this nature can progress beyond the report stage if its meaning and purpose are not made clear and understandable to the citizens of the area. In the final analysis they are the ones who will pay, directly or indirectly, for the pollution abatement works that are needed.

It is my hope that this program for the Mississippi-Des Moines-Skunk Rivers Basin will be carried through to completion so that the area may enjoy all the benefits that clean water can provide, in health and recreational opportunities for the people and in sound growth of industry and agriculture.

Leonard A. Scheele

Leonard A. Scheele
Surgeon General

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INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June 1948, requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies, and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary condition of surface and underground waters.

This report, prepared in cooperation with the water pollution control agencies of Iowa, Illinois, Minnesota, and Missouri, sets forth the water pollution control program being followed by the respective States in the Mississippi-Des Moines-Skunk Rivers Basin. This program, which is based on data available as of January 1, 1953, was developed after a thorough consideration of the existing and potential uses of the water resources in the basin; the pollution entering the streams and the resulting damages; the benefits which may result from pollution prevention and abatement; and the prevention measures now in effect as well as those which are needed.

Agencies which cooperated in the preparation of this report included the Iowa State Department of Health, Illinois Sanitary Water Board, Minnesota State Department of Health, and Missouri Division of Health. Likewise, acknowledgment is made to the Corps of Engineers, Department of the Army; Soil Conservation Service, Department of Agriculture; Bureau of Census, Department of Commerce; Bureau of Mines, Fish and Wildlife Service, and Geological Survey, Department of Interior; and the Federal Power Commission, for their review of the report and for the information gleaned from their published reports. Acknowledgment is also made of information obtained from the report of the Committee on Water Resources, Iowa State Planning Board.

MINNESOTA
IOWA
I O W A
ILLINOIS
MISSOURI
N
DOMESTIC WATER SUPPLY
INDUSTRIAL WATER SUPPLY
LIVESTOCK
IRRIGATION
COMMERCIAL FISHING
GAME FISHING
WILDLIFE
BATHING WATER
OTHER RECREATION
NAVIGATION
SCALE OF MILES
0 10 20 30 40
MISSISSIPPI-DES MOINES-SKUNK
RIVERS BASIN
EXISTING PRIMARY WATER USES
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 1

COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM
FOR THE
MISSISSIPPI-DES MOINES-SKUNK RIVERS BASIN

General Characteristics and Economic Development

The Mississippi-Des Moines-Skunk Rivers basin, with a total area of about 20,600 square miles, is composed of portions of the States of Iowa, Illinois, Minnesota, and Missouri. The greatest portion (86 percent) of the area lies in central Iowa with over 14,500 square miles included in the Des Moines River drainage basin and about 4,300 square miles drained by the Skunk River. The remaining area is drained by the Henderson River and Pope Creek in Illinois and directly to the Mississippi River.

In 1950 the basin population was about 1,030,000 and the population density was 50 persons per square mile, an over-all increase since the 1940 census of 5 percent.

The basin comprises a part of one of the most productive agricultural areas in the United States. From this region comes a large part of the nation's hogs and cattle, and the production of farm grains such as corn, wheat, and oats is of great economic value. At the same time, industrial production of such goods as cement, brick and tile products, farm and other machinery, dairy products, meat packing and associated products, etc., have grown to such an extent that the income from manufactures now very nearly equals the total farm income.

Low flows on the streams in this basin generally occur during the late summer, fall, and winter months. Critical flows on many of the streams in the area are very low, and only on the Mississippi and lower portions of the Des Moines River are minimum flows of sizable proportions. As a result, low flows become an important factor, and waste treatment, generally of a high degree, is necessary to provide water suitable for the desirable water uses.

Water Use and Water Quality Objectives

The waters of the streams are utilized for numerous purposes, including municipal water supply, industrial water supply, waste disposal, development of power, livestock watering, recreation, game fishing, and fish and wildlife propagation. Sixteen communities, with 53 percent of the total population living in communities of 1,000 or more, obtain their domestic water supply from surface sources. The amount of water used for industrial purposes is not known, but it is assumed to be sizable because of the extent of industrial expansion in this area. The generation of hydroelectric power is not a major industry, although there are 12 water power project developments on the stream having a total installed capacity of 9,200 horsepower. These streams and their tributaries are extensively used for livestock watering. Recreational use and fishing are popular in much of the Des Moines River and its tributaries and in the lower reaches of the Skunk River. The Mississippi River in the area included in this report supports an important commercial fishing industry.

Water quality objectives have been reasonably well established for most of the important water uses and are discussed in the body of this report. These criteria, together with desirable general sanitation objectives such as the removal of floating and settleable solids, elimination of nuisance conditions and the preservation of aesthetic values, provide a basis for the determination of the necessary degree of treatment for protection of existing and foreseeable legitimate water uses.

Sources and Effect of Pollution

Available information indicates that wastes with a known population equivalent of 530,000 are being discharged to the surface waters from 117 sewered communities with an estimated connected population of 461,000. Ten industries, for which the strength of organic wastes discharged through separate outfall sewers has been determined, add a pollutional load estimated to be equivalent to 123,000 people. Thus, the known municipal and industrial pollution discharged to the watercourses is equivalent to the wastes from over 653,000 persons.

There are 29 population centers that do not provide treatment for their wastes. Of these 29 communities, which have a population of nearly 20 percent of the basin's total sewered population, 28 discharge wastes with a population equivalent of almost 408,000 or 77 percent of the known municipal pollution. Eighty-two percent of all known municipal pollution discharged (on a basis of population equivalent) is received from four communities, viz., Ottumwa, Fort Dodge, Fort Madison, and Des Moines, Iowa. Both Fort Dodge and Des Moines provide treatment for their sewage.

Of the existing 118 municipal sewage treatment plants, 60 are considered to have inadequate capacity and 21 are not operated satisfactorily.

There are six industrial waste treatment plants which are considered to have inadequate capacity and four that are unsatisfactorily operated.

Wastes discharged from seven of the basin's communities create nuisance conditions which leave the water unsuitable for reasonable water uses. Low stream flows during droughts complicate the problem where pollutional loads are heavy.

The principal types of damages that have resulted from pollution of water resources in this basin are: introduction of health hazards near sources of public water supplies; impaired quality of water for livestock use; increased cost of treating water supplies for domestic and industrial use; depreciation of recreational use of streams.

Stream pollution abatement or prevention measures would result in elimination or reduction of these damages caused by pollution. Waste control programs within industries may well bring about greater utilization of raw materials and perhaps a profitable return on by-product recovery.

Progress in Pollution Abatement

Past progress in pollution abatement in a great part of this basin has been quite good when one considers that sewage treatment is provided by 105 of the basin's municipalities. The population served by these plants amounts to 80 percent of the basin's total sewered population. Of the 25 industries with separate outlets to streams, 10 treat their wastes. The majority of these existing sewage treatment plants were constructed between 1925 and 1940. This recognition of the problem is further pointed up by the fact that since the end of World War II nine new sewage treatment plants have been constructed, 10 plants have been replaced by new plants, and one plant has had major additions provided. Three new industrial waste treatment plants were completed in this same period. These sewage treatment plants involve a design population of 250,000, and for the industrial waste treatment plants the total design population equivalent is 16,200.

It is felt that the water pollution control laws of the States in this basin except Missouri are adequate to abate existing pollution and prevent or control new or increased sources of pollution. The State water pollution control programs have been quite successful, but in order for these agencies to pursue an effective and active program they must be furnished with adequate appropriations to attract sufficient trained personnel to carry on and expand their activities.

At the present time, 22 municipalities are either actively planning new sewage treatment facilities or have plans approved for such work and three municipalities have sewage treatment facilities under construction. Four industries have plans under preparation or approved for new treatment works, and one has a plant under construction.

Pollution Prevention Measures Required

The work that has been done on pollution control within recent years is most encouraging, but to adequately control or prevent continued pollution there are still a number of projects that must be built. Analysis of the available data which show stream flow characteristics, the amount of wastes discharged to the watercourses, present water quality in the streams, and existing water uses in relation to generally accepted water quality objectives has enabled the determination of treatment requirements for the major sources of pollution in the basin. These requirements consist of 52 new plants (29 for systems without treatment and serving 112,000 and 23 for systems with unsatisfactory treatment plants serving 19,500) and enlargements or additions to 37 existing plants serving 253,000.

It is estimated that the construction of these facilities will cost approximately $12,000,000. The cost estimate does not include such items as sewers, interceptors, land, right-of-way, etc., which will vary with every project and with local conditions. Neither do these figures include operation and maintenance costs.

There are eight new industrial waste treatment facilities, one enlargement, and three replacements required in order to adequately reduce the industrial pollution load now being discharged to streams in this basin.

Many of these needed plants will be small. No close estimate of cost of industrial waste treatment plants is possible since the nature of the wastes and possible process improvements vary widely within identical industrial groups.

Additional data will be required to completely determine the total pollutional load from all municipalities and industries. However, the data now available will allow the continuation of a reasonable comprehensive program for the elimination of many of the pollutional problems that now exist.

More efficient operation of existing facilities of several municipalities and industries is needed to reduce pollution from plants that can produce an acceptable effluent. The State water pollution control agencies and State health departments have personnel who are quite capable and willing to assist any municipality or industry in securing proper, efficient operation of their waste treatment facilities.

Water Pollution Control Program

The needed improvement measures discussed herein and listed below are based upon studies and observations by the responsible water pollution control agencies in the states concerned, which in some cases, did not include an investigation of pollutional conditions in the receiving stream. They are recommended on the premises of providing treatment facilities where such facilities do not now exist and for expansions and improvements to existing facilities where they are now not entirely adequate to protect the stream under all conditions. Thus the fact that they are included does not always indicate the existence of a pollutional condition which is seriously damaging to water use. Nevertheless, they are deemed advisable for restoring or protecting the stream for all legitimate water uses including those that now exist and those that may materialize in the foreseeable future.

The corrective measures listed below are flexible and are intended to reflect the needs for the present situation as it now exists; however, changes in stream characteristics, pollutional load, or water uses all may require revisions in the future in the treatment requirements needed.

1. Provide the following improvements:

Name and Location	Improvement Needed	Remarks
ILLINOIS		
Dallas City	New Treatment Plant	
Nauvoo	New Treatment Plant	
Warsaw	New Treatment Plant	
IOWA		
Adel	New Treatment Plant	
Albia		
North Plant	Additions to Existing Treatment Plant	
Rendering Plant	Replacement of Existing Treatment Plant	Final Plans Approved
Algona	New Treatment Plant	Final Plans Approved

Name and Location	Improvements Needed	Remarks
IOWA (Cont'd.)		
Armstrong	New Treatment Plant	
Bagley	Replacement of Existing Treatment Plant	
Bancroft	Additions to Existing Treatment Plant	
Baxter	Replacement of Existing Treatment Plant	
Bode	Additions to Existing Treatment Plant	
Boone	Enlargement of Existing Treatment Plant	Final Plans Approved
Brighton	Additions to Existing Treatment Plant	
Burlington	New Treatment Plant	
Iowa Ordnance Plant	New Treatment Plant	
Burt	Additions to Existing Treatment Plant	
Chariton		
Northwest Plant	Replacement of Existing Treatment Plant	Final Plans Approved
Northeast Plant	Replacement of Existing Treatment Plant	Final Plans Approved
Southwest Plant	Replacement of Existing Treatment Plant	Final Plans Approved
Churdan	Replacement of Existing Treatment Plant	
Corwith	Enlargement of Existing Treatment Plant	
Colfax	New Treatment Plant	
Dayton	Replacement of Existing Treatment Plant	
Des Moines	Additions to Existing Treatment Plant	Final Plans Approved
Eagle Grove	New Treatment Plant	Active Planning
Earlham	Additions to Existing Treatment Plant	
Eldon	New Treatment Plant	
Ellsworth	New Treatment Plant	
Estherville		
Rendering Plant	Replacement of Existing Treatment Plant	Active Planning
Farmington	New Treatment Plant	
Fonda	Replacement of Existing Treatment Plant	
Fort Dodge	Enlargement of Existing Treatment Plant	Final Plans Approved

Name and Location	Improvement Needed	Remarks
IOWA (Cont'd.)		
Fort Madison	New Treatment Plant	
State Penitentiary	New Treatment Plant	
Paper Mill	New Treatment Plant	
Gilmore City	Enlargement of Existing Treatment Plant	Preliminary Report
Gowrie	New Treatment Plant	Final Plans Approved
Creamery	New Treatment Plant	
Graettinger	New Treatment Plant	
Indianola		
North Plant	Replacement of Existing Treatment Plant	Under Construction In One Plant
South Plant	Replacement of Existing Treatment Plant	
Jewell	Replacement of Existing Treatment Plant	
Kanawha	Additions to Existing Treatment Plant	
Creamery	New Treatment Plant	
Keokuk	New Treatment Plant	
Keosauqua	New Treatment Plant	
Keota	Replacement of Existing Treatment Plant	
Lake City		
North Plant	Enlargement of Existing Treatment Plant	
Rendering Plant	Replacement of Existing Treatment Plant	
Laurens	Replacement of Existing Treatment Plant	
Lehigh	New Treatment Plant	
Lohrville	Replacement of Existing Treatment Plant	Active Planning
Madrid	Additions to Existing Treatment Plant	
Manson	Additions to Existing Treatment Plant	Under Construction
Maxwell	New Treatment Plant	
Mediapolis	New Treatment Plant	
Montezuma	Replacement of Existing Treatment Plant	Preliminary Report
Mt. Pleasant	Additions to Existing Treatment Plant	
State Hospital	Enlargement of Existing Treatment Plant	
Nevada	Enlargement of Existing Treatment Plant	
Newell	Enlargement of Existing Treatment Plant	

Name and Location	Improvement Needed	Remarks
IOWA (Cont'd.)		
New Sharon	Replacement of Existing Treatment Plant	Preliminary Report
Newton		
Northwest Plant	Enlargement of Existing Treatment Plant	Active Planning
South Plant	Enlargement of Existing Treatment Plant	Under Construction
Southwest Plant	Enlargement of Existing Treatment Plant	Active Planning
Ogden	Additions to Existing Treatment Plant	
Oskaloosa		
Northeast Plant	Additions to Existing Treatment Plant	Active Planning
South Plant	Additions to Existing Treatment Plant	Active Planning
Ottumwa	New Treatment Plant	Active Planning
Panora	New Treatment Plant	
Perry	Additions to Existing Treatment Plant	
Arnold Packing Plant	Replacement of Existing Treatment Plant	
Pomeroy	Replacement of Existing Treatment Plant	Active Planning
Redfield	New Treatment Plant	
Soybean Processing Plant	New Treatment Plant	Active Planning
Rippey	New Treatment Plant	
Rockwell City	Enlargement of Existing Treatment Plant	
Women's Reformatory	Additions to Existing Treatment Plant	
Roland	Additions to Existing Treatment Plant	
Sigourney		
East Plant	Additions to Existing Treatment Plant	
West Plant	Additions to Existing Treatment Plant	
Slater		
Creamery	New Treatment Plant	
Story City	Replacement of Existing Treatment Plant	
Stratford	Additions to Existing Treatment Plant	
Stuart	Replacement of Existing Treatment Plant	

Name and Location	Improvement Needed	Remarks
IOWA (Cont'd.)		
Swea City	Replacement of Existing Treatment Plant	Final Plans Approved
University Park	Replacement of Existing Treatment Plant	
Wallingford Creamery	New Treatment Plant	
Washington	Enlargement of Existing Treatment Plant	
Williams	Replacement of Existing Treatment Plant	
Winfield	Replacement of Existing Treatment Plant	
Winterset	Enlargement of Existing Treatment Plant	
MINNESOTA		
Currie	New Treatment Plant	
Heron Lake Village	New Treatment Plant	
Jackson	New Treatment Plant	Active Planning
Lake Wilson	New Treatment Plant	
Sherburn	Additions to Existing Treatment Plant	Contract awarded
Slayton	Additions to Existing Treatment Plant	
Wilmot	New Treatment Plant	
Worthington	Additions to Existing Treatment Plant	
Southwest Minn. Sanatorium	Replacement of Existing Treatment Plant or Connection to Municipal Sewer	Final Plans Approved
Rendering Co.	Enlargement of Existing Treatment Plant	Under Construction

2. Operation of all existing and future municipal and industrial waste treatment works be brought to a uniformly efficient and high level in order to obtain maximum benefits from these structures and permit their most effective utilization.

3. Continue the general policy of requiring adequate treatment of wastes from both new sources and expanded use of existing facilities in order to preclude new pollution problems.

PHYSICAL DESCRIPTION

The area included in this basin includes parts of four States, namely, Minnesota, Iowa, Illinois, and Missouri. The total area involved is approximately 20,570 square miles with Iowa having 86 percent of the total basin area. Of the remaining area, 7 percent is in Minnesota, 6 percent in Illinois, and less than 1 percent in Missouri. Over 14,500 square miles are included in the Des Moines River drainage area, about 4,300 square miles are drained by the Skunk River and the remaining area is drained by the Henderson River in Illinois and directly by the Mississippi River.

The basin, from the Mississippi River to the origin of the Des Moines River, is approximately 360 miles long and about 80 miles wide at the point of greatest width. The total area is roughly rectangular in shape with the long axis of the rectangle running in a northwesterly-southeasterly direction.

The Des Moines River rises in southwestern Minnesota and flows in a southeasterly direction across Iowa to the northeast corner of Missouri, where it joins the Mississippi River just downstream from Keokuk, Iowa. The stream is 535 miles long and has a total fall of 1,370 feet. The major tributaries to the main stream are the Boone River, and the Raccoon River.

The Skunk River rises in north central Iowa. The stream flows southeast about 264 miles, falling a total of about 680 feet, and enters the Mississippi River nine miles south of Burlington, Iowa. In the lower reaches, the water surface slope is affected by the pool level of Lock and Dam No. 19 at Keokuk, Iowa. The most important tributaries are the North Skunk River, Squaw Creek, and Cedar Creek.

Henderson Creek and Pope Creek are the principal streams in the Illinois section of this basin.

Generally speaking, the area drained by the Skunk River in Iowa and Henderson Creek in Illinois is devoid of lakes. However, in the upper reaches of the Des Moines River, in Minnesota and the northern Iowa part of this basin, there are several lakes of varying sizes.

Topography

The Des Moines River watershed lies in a glaciated area in which the maximum relief is about 200 feet. The upper reach of the stream valley is not well defined and the stream bed is only a few feet below the surrounding plain. As the stream flows south, it gradually cuts into the plain; rock ledges are encountered, and the stream valley becomes well defined. Below Des Moines, the stream meanders through a wide flood plain. In the lower reaches, the flood plain becomes wider and is bounded by rounded bluffs until the stream enters the Mississippi River flood plain. The valleys of the East Des Moines, Boone, and the Raccoon Rivers have the same general characteristics as the main stream above Des Moines.

The Skunk River, from its source to a point a few miles north of Ames, Iowa, flows through a narrow and shallow valley except for the lower five miles where the bluffs rise 75 to 1,000 feet above the river bed. Just below Ames, the river enters a pre-glacial channel and the valley widens considerably. From Ames, Iowa, through Mahaska County, the valley bottoms are moderately wide but from Keokuk County through Henry County, the valley is narrow and the river meanders through the bottoms. In Henry County the river enters a narrow, steep-walled valley where numerous rock outcrops occur in the stream beds and valley walls. These characteristics continue to a point below Augusta, Iowa, where the valley again becomes wide, finally merging with the flood plain of the Mississippi River.

In the Illinois section of the basin, the country drained by Henderson Creek and Pope Creek is gently rolling country with fairly high bluffs along the course of the Mississippi River. In general, these stream valleys are not wide and since the streams flow through deposits of Illinois drift, the width of the valleys varies with the resistance of the drift to erosion.

The entire Des Moines-Skunk River basin has been subjected to glaciation, some parts having been covered by at least three different ice sheets. The most predominant soils are associated prairie soils developed in the cool, moderately humid climate under the influence of a grass vegetation. These soils occupy a large part of the Corn Belt and rank among the best in production of corn and oats. Alluvial soils are found on low terraces along streams, first bottoms and flood plains. These soils come in a variety of material and are generally fertile and highly productive when drained and protected from floods. The range of soil texture is from sand to clay.

The sand and gravel deposits in glacial drifts supply a portion of the underground water used in the basin but most of it is derived from deep wells in rock. Water from these wells usually contains a large amount of dissolved minerals, whereas the water from glacial sand and gravel is of better quality.

Climate

The climate of the basin is temperate. The mean annual temperature is about 49°F. with January temperatures averaging about 14°F. in the northern part and about 24°F. in the southern sections. The average July temperatures vary from 73°F. in the north to 77°F. in the south. Extreme temperatures have ranged from below -30°F. to above 100°F. Precipitation ranges from approximately 28 inches in the northern portions to nearly 36 inches in the area along the Mississippi River. About 70 percent of the annual precipitation falls during the growing season from April through September.

Hydrology

The two main streams in this basin have a history characterized by great variations in flow. Past records have shown that the Des Moines River does not always have a good sustained low flow and there have been several periods when extremely low flows occurred in the river during extended drought.

On the other hand, serious floods have occurred particularly at Des Moines where the Raccoon River joins the main stem and at Ottumwa further downstream. At Ottumwa, the 31-year average flow was 4,633 c.f.s. but in January 1940, the minimum daily flow was 30 c.f.s. That same year the maximum daily flow recorded was 12,760 c.f.s. and in 1947, the maximum daily recorded flow was 126,000 c.f.s. At Des Moines, Iowa, on the Des Moines River, for 28 years of record, the average flow was 2,109 c.f.s. However, in January 1940 the minimum daily flow recorded was 24 c.f.s. and in 1947 the maximum daily flow recorded was 39,200 c.f.s.

On the Skunk River, the short length of the main stream and relatively steep slopes of the tributaries result in quick concentration of surface runoff and flood flows are rapid and flashy. However, extremely low flows have been recorded numerous times on this stream because of drought conditions or very heavy ice cover. At Ames, Iowa, in 1934, during the summer months there were several days of no flow in the stream. Between 1938 and 1948, there were four months in which the minimum daily flow was less than 1.0 c.f.s. The normal low-water flow at Ames averages about 2 c.f.s. Downstream at Augusta, Iowa, for a 33-year period, the average flow recorded was 2,226 c.f.s. Extreme flows on this stream at Augusta have varied from a minimum of 7 c.f.s. to a maximum of 44,800 c.f.s.

Low flows on the streams in this basin generally occur during the late summer, fall, and winter months although the streams in the Illinois section have low flow periods mostly during the late summer and early fall. Low flows on some of the minor tributaries have approached or reached no flow conditions during periods of extended drought.

The effects of pollution are increased during periods of low flow, both when temperatures are high or when the streams are covered with ice. During warm weather, the amount of oxygen that the stream water can absorb is considerably reduced and bacterial growth is accelerated. In periods of low temperature and heavy ice coverage, there is little opportunity for reaeration of the water and consequently, it is difficult for the stream to naturally overcome the effects of pollution. As a result, critical flows become an important factor in determining the waste treatment necessary to provide water suitable for the legitimate water uses.

ECONOMIC DEVELOPMENT

This basin with its large expanses of gently rolling prairie land and rich soil has, since it was first settled, been noted for its production of valuable agricultural products. A large part of the country's hogs and cattle and farm grains such as corn, wheat, and oats have come from this region. For instance, Iowa in 1948 had a cash farm income equal to 8 percent of the total cash farm income for the United States. In this same period, the value of cattle grown in the State of Iowa was equal to 7 percent of the United States total. The corn and hogs produced were equal to 20 percent and 25 percent, respectively, of the total raised in the United States. The farm income in this State, in 1948, was over 2 billion dollars with meat animals having a value of approximately 1.4 billions, dairy products being worth 183 millions, and poultry and egg products produced being valued at 195 millions of dollars.

Although agriculture is perhaps the most important industry in this basin, other industry, particularly manufacturing, has increased in extent and importance within the past two or three decades until it is now of such a size that the industrial income has become very important to the economy. Most of the larger manufacturing plants in the area are located in the five largest cities--Galesburg, Illinois, and Des Moines, Ottumwa, Fort Dodge, and Burlington, Iowa. The chief products of these manufacturing centers are: cement, brick and tile products, building materials, furnaces, foundry products, meat packing and associated products, rubber products, electrical goods, farm and other machinery, cereals and flour, dairy products, gypsum, plaster and associated products, washing machines, aircraft parts, and coal products. These five communities, in 1950, had over 23 percent of the entire basin population.

According to information obtained from "Census of Manufacturers, 1947" Bureau of the Census, it is estimated that the total value added to goods by manufacture was approximately $222,000,000. In this matter, the industry classified as food and kindred products led all other industries. The Mississippi River is used for commercial navigation but the value and tonnage of the freight handled at the port cities in this area is not known.

In 1950, the basin population totaled 1,030,600 with 89 percent residing in Iowa, over 6 percent in Illinois, 4 percent in Minnesota, and the remainder in Missouri. There are 41 communities with populations between 1,000 and 2,500; 26 communities with populations between 2,501 and 10,000; seven communities with populations between 10,001 and 25,000; and five communities with populations greater than 25,000. There are approximately 50 persons per square mile in this basin, an over-all increase, since the 1940 census, of 5 percent.

At the present time, there are 8 water power developments on the Des Moines River and its tributaries. These water power plants have a total installed capacity in excess of 8,400 horsepower. On the Skunk River, there are two water power developments having a combined capacity of 856 horsepower. All these plants are low-head installations and usually serve only the communities near which they are built. A hydroelectric development on the Mississippi River at Keokuk, Iowa, has a capacity of approximately 180,000 horsepower.

There are a considerable number of State parks, game refuges, and two National forests in this basin. The majority of the streams in this area, as well as the natural lakes located predominantly in the northern portion, afford good sports fishing. The extensive cover for many species of upland game birds and in those areas where there are lakes and marshy areas, large numbers of water fowl may be found.

USES OF WATER RESOURCES

Important uses of the basin's waters include: domestic, industrial and livestock supply; fishing; wildlife, bathing and other recreation; and navigation. The primary use is, in some cases, domestic supply but the predominant uses throughout the basin are livestock supply, fishing (mainly sports fishing), and wildlife. Navigation is limited to the Mississippi River.

Sixteen communities in this basin obtain their public water supplies from surface sources. These communities had a 1950 population of approximately 316,000 or 49 percent of the total population in municipalities with sewer systems. In 1949, the water treatment plants serving these 16 communities had a total output of 31.3 MGD. Eight of the 16 communities, with a total 1950 population of approximately '0,000, obtained their water supplies from the Mississippi River while the rema nder obtained their water supplies from the Des Moines River, Skunk River, R ccoon River or the tributaries thereto. All of the communities using surface water supplies provide complete treatment for the water. The largest community in the basin, Des Moines, Iowa, obtains its public water supply from infiltration galleries located parallel to and a short distance from the Raccoon River and may supplement this supply with water from the Raccoon River. Thus, it can be said that the city of Des Moines obtains its water from surface sources.

In order to judge the quality of finished water for domestic supply, some consideration is given to quality of the source water. Source water quality objectives are among the factors considered in determining requirements for pollution sources upstream. In determining suitability of source water for domestic supply, State health and water works officials generally use certain criteria as a guide. Such a guide is Public Health Bulletin 296, "Manual of Recommended Water Sanitation Practice," which has been widely accepted by those in the water works profession.

The raising of livestock is not only a primary agricultural activity but is an activity of great economic importance to this basin. The use of surface streams for livestock water supply is widely practiced and of paramount importance in the production of high quality livestock. Water quality objectives for stockwatering have not been precisely defined, but elimination of such pollution as floating and settleable solids and high bacteria counts will generally provide water quality satisfactory for stock use.

The quantity of surface water used by industry for cooling or process purposes, with or without treatment, is not known but it seems reasonable to assume that, with the importance that industry has reached throughout much of the basin, the quantity of surface water required and used must be large. Because of the diversity of needs, quality requirements for industrial water supplies vary widely, depending upon the needs of the industry under consideration. No general criteria have been adopted and each case must be considered separately. Of general concern are the organic and biological constituents, toxic substance, and properties of corrosion, encrustation, and slime formation of the available waters.

The Des Moines and Skunk Rivers and their tributaries are extensively used for recreational use including fishing, boating, cabin sites, camping, and picnicking. Since most of the larger Iowa lakes are confined to the northwest portion of the State, heavy angling pressure is applied to the inland streams and studies have shown over half of the fishing in Iowa is done along the streams. Part of the popularity is due to the fact that most of the cities, and therefore the greatest population, are adjacent to the rivers which are used during weekends and holidays during a large part of the year.

Most of the Des Moines River and its tributaries provide excellent catfishing with small-mouth bass, walleyed and northern pike being found in important numbers in many stretches of the basin. The Skunk River particularly in the lower reaches provides some of the finest catfishing in the entire State. Sports fishing in the Mississippi River in the reach covered by this report is popular and commercial fishing on the river is a substantial industry.

The U. S. Fish and Wildlife Service has set forth certain criteria necessary for fresh-water fish. The criteria state that a minimum of 5.0 p.p.m. dissolved oxygen is necessary; a low density of ionizable salts, a pH between 6.5 and 8.5 and an ammonia content less than 1.5 p.p.m. are considered important to maintain optimum conditions for fish. These authorities also agreed that a balanced aquatic life must exist to support fish life; sludge beds, silt sedimentation, and other deposits which tend to blanket the stream bottom and destroy the biological life so vital to the existence of fish are highly undesirable in streams which are to support fish life.

Due to the relatively low heads and irregular flow now available in the drainage basin, power development is not at present considered an important water use.

All of these water uses are considered essential for the improvement of the economical conditions, health, and welfare of the people in the basin, and conservation of the water resources will be necessary for the continued development of the area. Treatment of the wastes discharged to the watercourses will be necessary to achieve the pertinent water quality objectives and thus maintain the streams in a suitable condition for the indicated water uses.

POLLUTION CONTRIBUTED TO WATER RESOURCES

In the Mississippi-Des Moines-Skunk Rivers Basin there are 134 population centers served by sewerage systems having a connected population of over 547,000. For 117 of these on which data is available, the amount of pollution discharged to watercourses was equivalent to almost 530,000 1/ people although the population actually served by these sewerage systems was only 461,000. This indicates that a large amount of industrial waste is being discharged to municipal sewerage systems. Eighty-two percent of all known municipal wastes discharged (on the basis of population equivalent) is from four communities, viz., Ottumwa, Fort Madison, Fort Dodge, and Des Moines, Iowa. Both Fort Dodge and Des Moines provide sewage treatment.

TABLE A
SEWERED MUNICIPALITIES*

Municipalities*	Number	Population Served by Sewerage System	Amount of Pollution Discharged to Watercourse (In Terms of Equivalent Number of People)
Having data on pollution load discharged to watercourse	117	460,850	529,725
Having population data available (Data on pollution load to watercourse incomplete or not available)	17	86,513	Not applicable
TOTAL	134	547,363	xxx xxx

* Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers; sanitary sewage wastes discharged by industry directly to watercourse and industrial wastes discharged into municipal sewage systems.

Ten industrial establishments discharge organic wastes through separate outfall sewers contributing a known pollutional load equal to wastes from a population of almost 123,000. Besides these 10, there are 12 other organic waste producing industrial plants for which pollution data are not available and two which discharge waste to lagoons. Two plants produce both inorganic and organic wastes.

1/ This figure includes wastes of a large packing plant which plans to treat its waste and discharge the effluent through a separate outfall.

TABLE B
SEPARATE INDUSTRIAL* OUTLETS

Industries*	Number	Amount of Pollution Discharged to Watercourse (In Terms of Equivalent Number of People)
Producing Organic Wastes	12 [1]	122,650
Producing Organic Wastes	12 [2]	Not known
Producing Inorganic Wastes	2	Not known
TOTAL	25	xxx xxx

* Industries having separate outlets discharging wastes directly to watercourse.

[1] Includes two plants which discharge wastes to lagoons.

[2] Includes one plant which also produces inorganic wastes.

On the basis of population equivalent, the above statistics indicate that the total known sewage and industrial liquid organic wastes discharged to the watercourses are equivalent to the wastes from over 653,000 persons. This is 35 percent more than the sewered population whose wastes discharged are reported.

Of the 134 population centers with sewerage systems, there are 29 that do not provide treatment for their wastes. These 29 communities have a sewered population totaling over 112,000, which is approximately 20 percent of the entire sewered population. The pollution load determined for 28 of the 29 communities is almost 408,000 people, or over 77 percent of the known municipal pollution discharged to watercourses in this basin.

At Ottumwa, Iowa, where there is no sewage treatment plant and the sewered population is about 35,000, it is estimated that the pollution load discharged to the Des Moines River amounts to 330,000 population equivalent, or nearly 62 percent of the total known municipal pollution discharged to watercourses. A large meat packing concern discharges to the city system untreated wastes with a population equivalent to 10 times the domestic sewage. Both the city and the packing plant have plans for separate treatment facilities under way.

In the group of 29 municipalities without sewage treatment, 16 have sewered populations of 1,000 or less, 9 are between 1,001 and 5,000, three are between 10,001 and 25,000, and one is between 25,001 and 50,000.

In addition to the pollution load added by untreated wastes discharged to watercourses, the major portion of the remainder of the pollutional load is created by the discharge of effluents from 60 existing municipal sewage treatment plants with inadequate capacity. These plants serve a total sewered population of 272,000 and discharge a pollutional load to the streams of 94,000 population equivalent.

Another source of municipal pollution that must be considered is that caused by sewage treatment works that are adequate as far as capacity is concerned but are poorly operated. Nineteen such treatment plants discharge wastes with a combined strength equivalent to that from 9,000 people.

Most of the known pollutional load discharged by industries is received from six plants which have no treatment facilities. In addition, there are five other industries without treatment facilities for which the pollutional load is undetermined. There are also four industries with existing treatment facilities that are considered to have inadequate capacity.

Probably the most critical stream conditions occur at Ottumwa, Iowa, on the Des Moines River where treatment is not provided and where the municipal sewers receive a very large quantity of industrial wastes, principally from a meat packing company. Conditions are such at this point that all legitimate water uses are damaged and nuisance conditions exist. There are, in addition, six other communities, which are considered to have pollution problems serious enough to cause nuisance conditions and render the watercourse unsatisfactory for all legitimate water uses. In several instances, the majority of pollution added to the streams in the foregoing communities is created by wastes from food-processing industries of one type or another. Heavy pollutional load is discharged to the stream at Fort Madison, Iowa, and Keokuk, Iowa, but the flow in the Mississippi usually furnishes considerable dilution. In Minnesota, at practically all communities listed as discharging untreated wastes to watercourses, the pollution is said to be such that the streams immediately below these communities are unsatisfactory for all legitimate water uses and, of course, during periods of low flow in the streams, the situation is aggravated. A major community in Minnesota where these conditions exist is Jackson.

Siltation of some of the major streams in this basin has also added to the pollutional load in certain sections.

DAMAGES TO WATER RESOURCES FROM POLLUTION

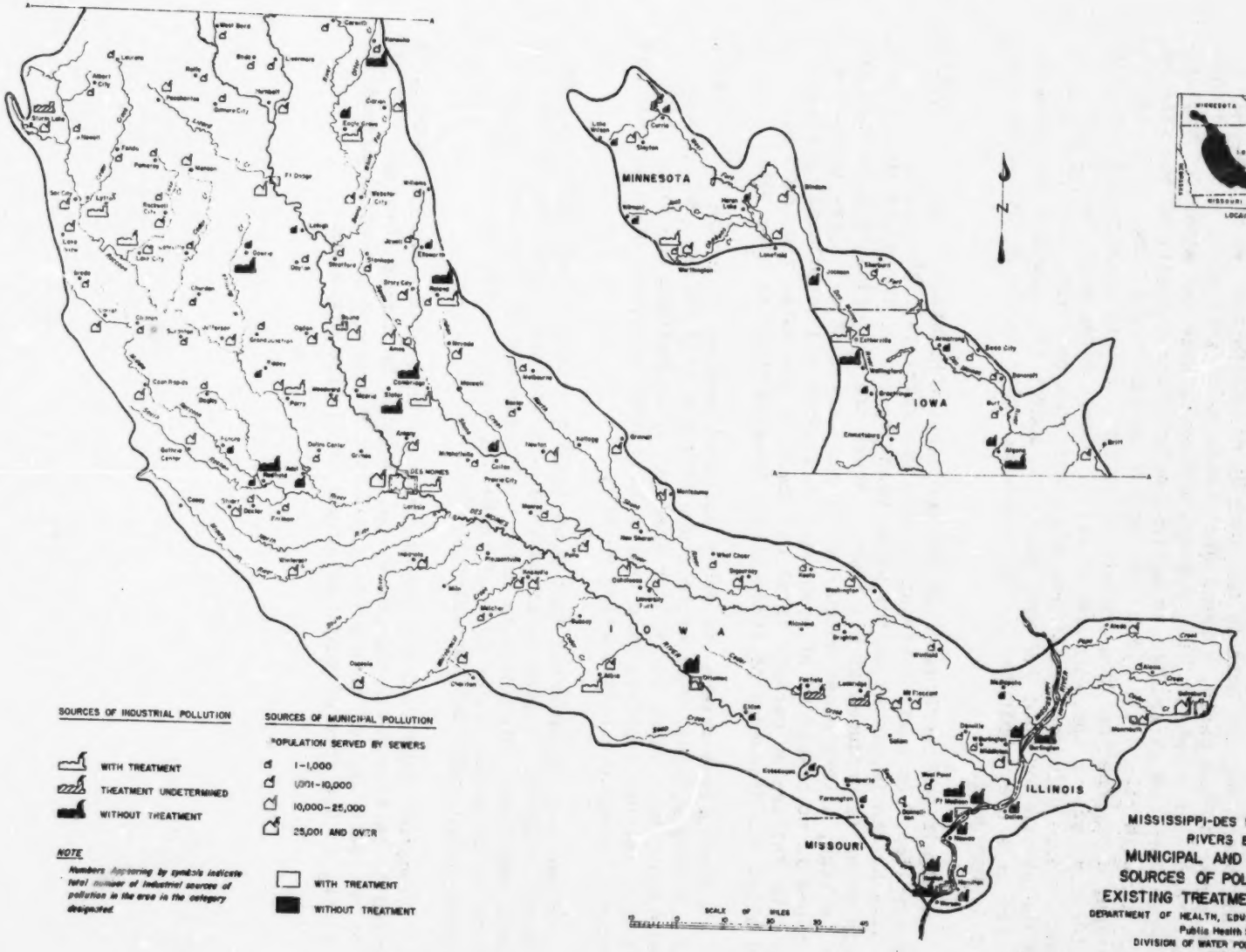
In certain areas pollution has caused damage to legitimate water uses. The amount of damage varies with the degree of pollution and depends upon the extent to which the major existing water uses are affected and potential water uses are held in abeyance by unsatisfactory water quality. In some areas of the basin, streams are undamaged by pollution, either because of the absence of sources of heavy pollution or because the amount of wastes discharged does not exceed the pollution assimilation capacity of the streams consistent with other water uses. Water use damages result from bacterial pollution, deoxygenation from organic pollution, toxicity, increased hardness, chloride content, or the presence of color, odor, or taste producing substances. Where nuisance conditions are considered to exist, all water uses along the stream for some distance below the source of pollution are damaged and other uses are prohibited by the excessive pollution load with which the stream is burdened.

A significant percentage of the municipal population obtains its public water supplies from surface streams. When raw water is highly polluted an increased burden is placed on the water plant operators to insure that a safe, potable water is produced at all times. Where the bacterial load in the raw water is high, a very close watch must be maintained at all times to insure that there is no breakdown of treatment facilities and sterilization equipment. The failure of certain vital equipment in the water treatment plant could allow the discharge of inadequately treated water to city mains.

Where surface waters are badly polluted because of sewage or industrial waste discharges, additional expenditure of funds will be required to adequately treat this water for either domestic or industrial use since chemical costs will increase, and in some cases, additional equipment will be required in order to produce a satisfactory water.

Water used by industry must meet quality standards dependent upon the processes involved. Boiler water must be soft and non-corrosive; the canning of foods requires a high quality water with a minimum of dissolved solids; bottling works need a water free of taste and odors and the absence of organisms which might develop aftergrowths.

Livestock watering, the predominant use made of the basin's waters, is reported to be frequently damaged by pollution. The damage involves loss of use of the water in the more grossly polluted reaches or potential hazard to the stock, in the form of toxic materials or disease organisms.



MISSISSIPPI-DES MOINES-SKUNK RIVERS BASIN
MUNICIPAL AND INDUSTRIAL SOURCES OF POLLUTION AND EXISTING TREATMENT FACILITIES

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 2

Sports fishing has also suffered from pollution. In cases of heavy pollution to those where nuisance conditions obtain, and even in cases of mild pollution where stream flows are reduced considerably at times of drought, fish propagation is made difficult if not impossible. This damage causes loss to the sportsman in the form of increased costs for traveling to waters where fishing is possible.

Recreation is not reported as frequently as a water use as it might be were all pollution abated. This activity has been depreciated and even completely eliminated in some cases by pollution.

Not to be overlooked is the damage to property value. Condition of the water is an important consideration to be made in locating on or near, or otherwise developing, waterfront property. There is little doubt that property value has suffered some loss due to pollution in the basin.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

Admittedly, pollution abatement activities cost money but the cost is relatively small compared to the long-range benefits which will accrue. Preserving and improving the waters of this basin for agricultural use will certainly be of considerable benefit because of the importance of this industry to the entire economy of the area. Furthermore many industries will benefit from pollution control measures adequate to assure the usability of all water resources for process or cooling water insofar as quality is concerned. With a continuation of the rate of population growth and an increasing expansion of industrial activities, an active and vigorous program of pollution control activities will be necessary to avoid any future decline or continued degradation of the quality of the water resources in this region.

The benefits to be expected in the provision of clean water for livestock in an area so predominantly agricultural are almost self-evident. A good water supply and healthy animals are essential to profitable livestock farming. This water must be palatable in addition to being free from the threat of becoming contaminated with disease organisms.

In the case of public water supplies, the benefits will be evidenced by the production of safe and potable water at reduced treatment costs, and for industries requiring large quantities of clean water, the decreased treatment costs will be appreciable. There are certain areas where existing ground water levels are declining and it may be necessary for some communities or industries to obtain their future water supplies from surface sources. In these cases, the first cost of such treatment plants may well be reduced if the source of supply does not require extensive treatment.

Some industries in achieving pollution abatement have realized some monetary returns through by-product recovery and utilization of wastes formerly discharged to streams. In the meat packing industry, a number of plants have introduced programs to salvage packing house wastes and have thereby increased greatly the recovery of blood, grease, and other materials for which a market has been found. At the same time, they have reduced the amount of pollution load discharged to streams.

Another benefit to be realized from a good pollution prevention program is the enhancement and expansion of existing and potential fish and wildlife conservation and recreational facilities. Reduction in travel distances to recreation areas where good fishing can be expected may represent sizable savings to the individual angler.

The above listed benefits are but a few of the items on the credit side of the ledger. Certainly they outweigh many times over the cost of obtaining these benefits.

POLLUTION PREVENTION MEASURES IN EFFECT

One hundred and five of the 134 municipalities in this basin with sewer systems provide treatment for their wastes. Thus, treatment is provided for 80 percent of the contributory population.

TABLE C
EXISTING TREATMENT FACILITIES
MUNICIPAL

Degree of Treatment Provided	Number Municipalities*	Plants	Population Served
Primary	6	6	4,515
Secondary	99	112	430,878
No Treatment	29	--	111,970

* Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers, industrial wastes discharged into municipal sewage systems.

Sixty existing municipal treatment plants, however, are reported to have inadequate capacity and do not give the degree of treatment which may ordinarily be expected from these plants. Fifty-seven plants are considered to have satisfactory capacity and 92 of the existing plants are believed to be operated satisfactorily. A number of the plants now classified as having inadequate capacity are planning for improvements required to provide sufficient capacity to satisfactorily handle the loads expected. Among some of the larger municipalities where planning is being carried on to increase the capacity of existing plants are: Des Moines, Newton, Fort Dodge, and Chariton, Iowa.

Table D, below, classifies the industrial sources of pollution according to the type of industry and shows the number of each type of industrial plants which provide treatment for their wastes. It will be seen that there are two predominant industries having separate outlets for discharging wastes directly to receiving waters--the food processing industry and the chemical and allied products industry. In this latter classification, rendering plants provide the major source of chemical products produced. The table shows that there is a total of 25[1]/ industrial plants discharging wastes and that 10 have provided treatment facilities, 12 have not, and the facilities for three are undetermined. Six of the existing treatment plants are satisfactory insofar as capacity is concerned but four are not.

1/ Includes two plants using lagoons.

TABLE D
EXISTING TREATMENT FACILITIES
INDUSTRIAL*

Type of Industry	Number of Plants	Number of Industrial Plants Having: Treatment Facilities	No Treatment Facilities	Undetermined Facilities
Food and Kindred Products	10[1]/	4[1]/	5	1
Chemical and Allied Products	11	5	4	2
Paper and Allied Products	1	0	1	0
Fabricated Metal Products	3	1	2	0
TOTAL	25	10	12	3

* Industries having separate outlets and discharging wastes directly to watercourse.

1/ Includes two plants using lagoons, which do not discharge a population equivalent load to the watercourses.

The largest known quantity of industrial pollution discharged directly to watercourses is that from the paper mill at Fort Madison, Iowa, and the next largest known quantity of pollution discharged is at Perry, Iowa, where the wastes from a meat packing plant, after passing through a primary treatment plant, discharge to Beaver Creek, which is a tributary of the Des Moines River. There are several industries for which the pollutional load discharged to the streams has not yet been determined. The Iowa Ordnance Plant at Burlington discharges both organic (of undetermined population equivalent) and inorganic wastes directly to a stream tributary to the Mississippi River.

All of the watershed area in the States of Iowa and Illinois and approximately 25 percent of the area in Minnesota is now organized in Soil Conservation Districts. The Soil Conservation Service working through these districts provides technical assistance to the farmers in installing conservation practices such as contour farming, contour strip cropping, terracing, and improved rotations. All of these practices definitely tend to reduce the sediment loads of the streams in this watershed, bringing about a reduction in the cost of filtering public water supplies and a reduction in damage to fish life.

TABLE E
ADEQUACY OF EXISTING TREATMENT FACILITIES

Existing Treatment Facilities	Number	Adequacy with Relation to: Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	118	57	60	1	92	21	5
Industrial	10	6	4	0	4	4	2

The large number of existing municipal waste treatment plants with unsatisfactory capacity is probably due to the fact that so many have been in use for long periods of time. The communities have increased considerably in population and industrial expansion was very marked, thereby seriously overloading these plants. For instance, 34 are over thirty years old and one of these has been in service for 40 years; 15 plants have been in service between 20 and 30 years; and 36 were built from 10 to 20 years ago. This situation is particularly true in the smaller communities where funds have not been provided for alterations and additions to existing works as population loads increased. Although there are a large number of existing plants that have grown old in service, this emphasizes the fact that the problem of stream pollution control has been recognized in this basin for many years. Between 1912, when the first plant was placed in operation, and 1940, 80 percent of the existing sewage treatment plants were constructed in this basin, with the majority of these plants being built between 1925 and 1940. This rapid progress indicates that the people residing in the region recognized that a pollution problem existed and that there was a need to control it. The recognition for the need of a continued pollution control program is evidenced by the fact that since the end of World War II nineteen new municipal sewage treatment plants (10 of which replaced existing plants) have been constructed and major additions have been made to one existing plant. In addition, three industrial waste treatment plants have also been completed in this same time period. The sewage treatment plants were designed to handle a population greater than 246,000 and the industrial waste plants were designed to handle a total of over 16,200 population equivalent. The work that has been done and is being done to control pollution is encouraging but there are certain points on the streams in this region where additional pollutional control work is badly needed.

TABLE F
PROGRESS IN POLLUTION ABATEMENT

Year	Municipal		Industrial	
	Plants Completed	Design Population	Plants Completed	Amount of waste treated (in terms of equivalent number of people)
1946	1	500	0	--
1947	0	--	1	1,500
1948	0	--	0	--
1949	8	106,370	1	14,000
1950	7 1/	107,200	1	700
1951	3	32,700	0	--
1952	1	3,500	0	--

1/ Includes two plants for which design populations are not given.

From the amount of construction that has been completed in the past years, it is evident that the State water pollution control agencies have been doing an excellent job; however, the activities of the agencies concerned have been somewhat hampered by lack of sufficient trained personnel and sufficient appropriations to properly expand their activities to meet the increased problems that confront them. Nevertheless, it is encouraging to note that in recent years State legislatures have increased appropriations for water pollution control work. It will be necessary to provide adequate appropriations, however, if an efficient, well-operating pollution control organization is to be maintained to cope with the problem.

It is believed that in general the water pollution control laws of these States with the exception of Missouri are adequate to abate existing pollution and prevent or control new or increased sources of pollution. The water pollution control agencies have been given sufficient legal authority with which to carry on their programs and they have used this authority judiciously and effectively in carrying out their work. The following brief analysis presents the salient features of water pollution control legislation of three of the States in this basin. A summary of the Missouri legislation is not included since only a very small portion of this State is included in this basin.

In Minnesota a comprehensive State water pollution control act was enacted in 1945 with authority vested in a Water Pollution Control Commission. The State Department of Health also has certain water pollution functions relating to public health and sources of water supply for domestic use.

The Commission is given the power and duty to make such administrative classifications of the waters of the State as it may deem advisable and establish reasonable pollution standards of the waters of the State in relation to the public use to which they are or may be put. Also, the Commission has the power and duty to approve plans for disposal systems; to issue, continue in effect, or deny permits for the discharge of wastes or for the installation or operation of disposal systems or parts thereof; and to revoke or modify any permit when necessary to prevent or abate pollution of any waters of the State. The Commission is authorized to hold hearings and issue orders, if necessary, to prevent pollution. Although the Commission is a separate and distinct entity, all investigations and other staff functions are performed by the Department of Health. There are no geographical or functional exemptions from the operations of the State water pollution control act.

In Iowa the water pollution control act vests the principal authority in the State Department of Health. The Iowa Natural Resources Council and the State Geologist also have certain functions relating to water pollution. The Iowa Natural Resources Council makes surveys of health and pollution problems relating to flood control. The State Geologist is responsible for protection of waters from pollution by oil or gas wells.

There is no specific statutory authority granted to the State Department of Health to develop a comprehensive program, to set standards of water purity, or to classify waters. However, the Department is authorized to exercise general supervision over public health, promote public hygiene and sanitation, to investigate and prevent water pollution, and to make necessary rules. The Department is authorized to issue written permits, after approval of plans and specifications, for new sewerage or industrial waste systems as well as extensions or additions which would substantially increase water pollution. The Department may hold public hearings on water pollution and may order abatement of pollution. However, the order cannot be issued without the written approval of the majority of the members of the Iowa Natural Resources Council. Penalties are provided for violations of orders issued or unlawful pollution of State waters. There are no exemptions from the operation of the act, since removal in 1949 of the restrictions under which the authority of the department did not apply to the border streams. The last amendments to the existing statutes of the State of Iowa considerably strengthen previous water pollution control legislation, under which a large measure of progress was made. Disposal of garbage and night soil into streams or on land subject to overflow is prohibited by an old statute not under direct administration or enforcement by the State Department of Health.

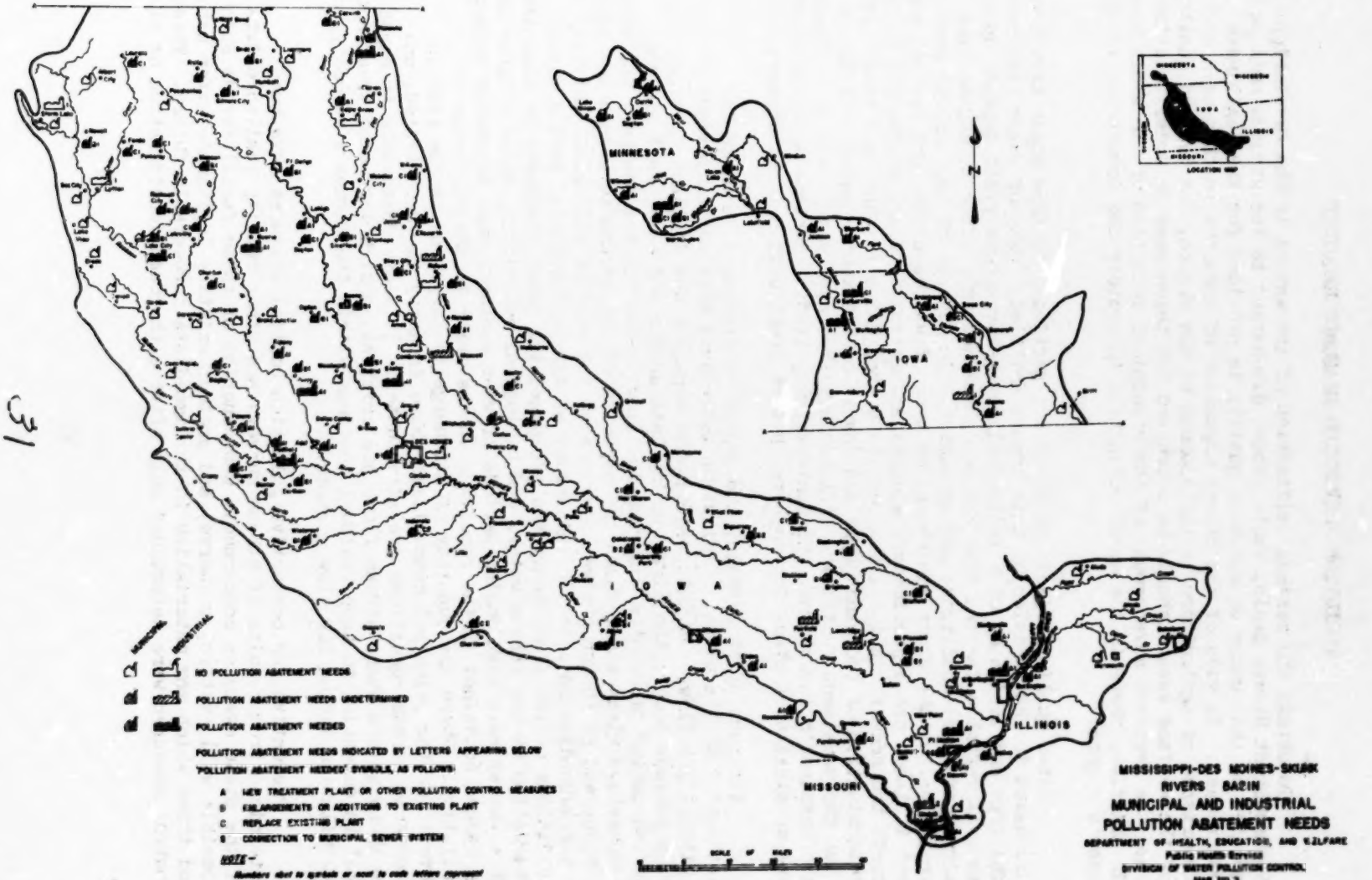
In Illinois control of water pollution is vested in the Sanitary Water Board under the Act of 1951, which superseded the Act of 1929. The Board has the authority to carry on comprehensive water pollution control programs, adopt rules and regulations, hold hearings, issue orders, and has authority to recover money sufficient for restoration of fish life which has been destroyed as a result of the violation of the act. The law also provides other

penalties for violation of the act and enables the Board to control or prevent new or increased sources of pollution. The 1951 Act included provisions for requirement of certification of municipal sewage treatment plant operators as well as industrial waste treatment plant operators. The Sanitary Water Board Act does not apply to any existing sanitary district having a population of one million or more. There is some overlapping of jurisdiction between the Sanitary Water Board and the Conservation Department which protects fish and wildlife from pollution. Pollution originating from oil field wastes comes under jurisdiction of the Department of Mines and Minerals.

Formal orders to municipalities and industries for abatement of pollution have not been widely used as an administrative procedure in this basin. Instead, water pollution control agencies of the States have preferred to use a cooperative approach working closely with polluters in an attempt to secure abatement without exercising police powers. Generally formal orders have been used only in those cases where the cooperative approach has not been successful.

The water pollution control agencies of Illinois and Iowa (and Wisconsin) have jointly resolved (in a meeting held at Davenport, Iowa, on March 7, 1952) that, insofar as the Mississippi River is concerned, each does "agree to require the correction of existing and prevention of additional pollution within the boundaries of its State to the end that said waters may be maintained or rendered suitable for all purposes heretofore defined and that in the attaining of these objectives the guiding policy shall be the requirement that facilities for treatment of sewage and for industrial wastes shall provide at least effective sedimentation or equivalent, substantially complete removal of floating solids or liquids, and reduction of toxic materials to less than lethal limits for aquatic life, with the understanding that additional or special type treatment be required in those areas where water uses so dictate...."

The States also have a policy of not issuing permits for construction of new sewer systems or extensions of existing ones unless the community requesting the permit has, or is actively planning to construct, adequate treatment facilities, where such action is authorized by their respective laws.


MINNESOTA
IOWA
ILLINOIS
MISSOURI
NO POLLUTION ABATEMENT NEEDS
POLLUTION ABATEMENT NEEDS UNDETERMINED
POLLUTION ABATEMENT NEEDED
POLLUTION ABATEMENT NEEDS INDICATED BY LETTERS APPEARING BELOW 'POLLUTION ABATEMENT NEEDED' SYMBOLS, AS FOLLOWS:
A NEW TREATMENT PLANT OR OTHER POLLUTION CONTROL MEASURES
B ENLARGEMENTS OR ADDITIONS TO EXISTING PLANT
C REPLACE EXISTING PLANT
S CONNECTION TO MUNICIPAL SEWER SYSTEM
NOTE –
Numbers shown to right of symbols or next to each letter represent number of pollution abatement needs in the category designated
MISSISSIPPI-DES MOINES-SKUNK RIVERS BASIN
MUNICIPAL AND INDUSTRIAL POLLUTION ABATEMENT NEEDS
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 3

POLLUTION PREVENTION MEASURES REQUIRED

To obtain the maximum utilization of the waters in the Mississippi-Des Moines-Skunk Rivers Basin, waste waters discharged to the streams must be treated so that water of suitable quality is provided for the legitimate water uses. In view of the recent expansion of industry in this area and the importance of agriculture to the economy of the region, the desired quality of the surface waters should be preserved for these uses in order to stimulate the greatest advancement of the economical condition of the whole basin. In addition, there is the moral obligation to protect the downstream water user's rights.

Water quality objectives which are pertinent to this basin have been discussed in that section of this report entitled, "Uses of Water Resources." The type and design of each individual sewage treatment plant depends upon several variable factors that can be determined only after an engineering survey of local conditions and economics. In several of the smaller problems in the basin, the exact amount and/or type of wastes discharged are not known, but in these cases preliminary studies and estimations are sufficient to set forth the need for a local engineering survey which in turn will result in the determination of the exact type and degree of treatment needed. To insure that the treatment facilities will satisfy the requirements and to safeguard the taxpayer's investment, the State water pollution control agencies require the submission of plans for approval before construction is undertaken.

For much of this basin, the degree of treatment required is influenced by the amount of dilution water available during periods of critical low flow. In this region, two separate and distinct critical stream flow periods occur; the first during late summer and early fall and the second during mid-winter. During low flow periods in hot weather, the water temperature rises and reduces the capacity of the stream to absorb and hold oxygen, and at the same time, accelerates the rate of biological activity with a corresponding increase in the amount of oxygen required. During winter conditions of low flow, heavy and prolonged ice cover precludes or diminishes reaeration of the stream water, and biological activities, while progressing at a lesser rate than during periods of warm weather, must be wholly supported by oxygen contained in the receiving waters prior to the discharge of pollution. Where the quantity of discharge is large, as is the case in several of the principal communities where industry is concentrated, undesirable stream conditions are accentuated. It seems reasonable to expect at those points where stream flows are critical, a high degree of treatment will be essential to keep residual loadings within the stream's capacity for assimilation during low flow periods.

Preventive and corrective pollution control measures have been determined from results of stream surveys and other readily available data of the State agencies concerned. Construction of these facilities as soon as possible will restore, preserve, and protect existing legitimate water uses and those which may materialize in the immediate foreseeable future. These control measures were determined only after a thorough consideration of all

water uses and are considered to be reasonable and adequate. At the same time, it should be kept in mind that the corrective measures are intended to be flexible and to reflect the needs of the existing situation; however, changes in stream characteristics, pollutional load, or water uses may require that revisions be made in the indicated treatment required at some future date.

Although considerable progress has been made in the Mississippi-Des Moines-Skunk Rivers Basin in providing municipal and industrial waste treatment plants, much additional plant construction, replacement, and expansion are needed before all waters of the basin will be adequately protected from the effects of municipal and industrial pollution. Also, there is a need for improvement of operation at a number of municipal and industrial waste treatment plants. Failure to operate waste treatment works at, or near, the peak of efficiency for which they were designed means that clean streams are not obtained as estimated and funds spent in anticipation of clean streams are largely wasted.

The presently available information shows that there are 29 new sewage treatment plants needed to serve an estimated total of 112,000 persons. One of these new plants is needed to serve a community with a sewered population greater than 25,000, three are needed for sewered populations between 10,000 and 25,000. Nine plants are needed to serve communities with connected populations between 1,000 and 5,000, and 16 new plants are needed in communities with sewered populations of 1,000 or less.

There are 23 existing sewage treatment plants that, because of age or gross overloading, are no longer efficient and should be replaced. These plants now serve a total sewered population of 19,500. In addition, there are 37 existing municipal waste treatment plants, now serving an estimated sewered population of 253,000, to which enlargements or additions should be made so that these facilities can do an adequate and proper job in controlling stream pollution.

There are, in contrast to the above requirements, 56 existing municipal sewerage systems, with a total connected population of 161,000 that are considered to be completely satisfactory for present conditions and no additional treatment is required for these communities.

Considering the number of new municipal waste treatment facilities needed, as well as those which should be enlarged or replaced, using available cost data and making reasonable approximations of unknown cost factors, it is estimated that the cost of constructing the needed treatment facilities would total about $12,000,000 for this basin. An accurate estimation of the cost of construction of needed community waste treatment facilities is difficult since the cost of each project will depend upon local factors. It is to be remembered that the cost estimate given covers treatment facilities only and that cost of collection sewers required to deliver sewage to the treatment plant is not included.

TABLE G
REQUIREMENTS FOR MUNICIPAL AND INDUSTRIAL
WASTE TREATMENT PLANTS

Requirements	Municipal Number	Municipal Population Served by Facilities	Industrial Number
New Plant	29[1]/	111,670	8
Enlargement or Additions to Existing Plant	37	253,298	1
Replace Existing Plant	23[2]/	19,465	3
No Project Required	56	161,430	6
Undetermined	1	1,500	7

1/ Includes one municipality whose interceptors serve another municipality, and one new plant is required for the two municipalities.

2/ Includes one plant which will replace two existing plants.

Of the 25 known industrial plants with separate waste outlets, eight require new waste treatment plants (or outlets to municipal sewerage systems with treatment), one requires an enlargement, and three should be replaced. The greatest number of industries requiring new waste treatment plants or replacement of existing facilities are classified under the food and allied products listing. On the basis of admittedly incomplete information, it is estimated that the cost of industrial waste treatment facilities needed in this basin would total between one and two million dollars. This rough approximation is made with the realization that before an accurate estimate of the cost of needed facilities can be made some additional information on the quantity and strength of the various wastes discharged must be known at certain plants in order to determine more accurately the degree and type of treatment required. It is also realized that certain in-plant changes in operation and housekeeping may not only result in a decrease in the quantity and strength of waste discharged to watercourses but will also markedly decrease the total cost of treatment facilities required.

TABLE H
STATUS OF TREATMENT WORKS PROJECTS TO ABATE POLLUTION
JANUARY 1, 1953

Status of Project	Number	
	Municipal	Industrial
No Formal Action	0	5
Plans Under Preparation	12	3
Final Plans Approved	10	1
Under Construction	3	1
Status Undetermined	65	9

In Table H is presented the currently available information on the status of projects to abate water pollution in this basin. It will be seen that there are 10 municipalities that have had final plans approved, 12 that have plans under preparation, and three with plants now under construction. Those communities with plans under preparation or approved now have a total sewered population of 254,000, or more than 46 percent of the basin's sewered population.

Three industries have plans under preparation, one has final plans approved and one has a waste treatment plant under construction.

In addition to construction needs, intensification of State water pollution control educational programs is important to long-range planning and good administration by water pollution control agencies. The undesirable effects of pollution on public health and water conservation must be presented to the public if its support of water pollution control measures is to be expected. In both municipalities and industries, responsible officials should be acquainted with expected treatment needs so that needed improvements are planned for well ahead of the time when these needs become an actuality and damage to the stream has occurred.

APPENDIX

TABLE 1

BASIC DATA ON SOURCES OF MUNICIPAL* POLLUTION

MISSISSIPPI-DES MOINES-SKUNK RIVERS BASIN

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Water-courses**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
MISSISSIPPI RIVER:									
Burlington, Iowa		25,000	--	None	--	--	Undet.	New Plant	Undetermined
Burlington (Small plant)		1,500	1,500	Secondary	Undet.	Undet.	Undet.	Undetermined	Undetermined
W. Burlington, Iowa		Served by Burlington Sewer System							
Dallas City, Ill.		1,100	1,100	None	--	--	1,100	New Plant	Undetermined
Fort Madison, Iowa		14,000	50,000	None	--	--	50,000	New Plant	Undetermined
State Penitentiary		1,100	1,100	None	--	--	1,100	New Plant	Undetermined
Nauvoo, Ill.		1,100	1,100	None	--	--	1,100	New Plant	Undetermined
Hamilton, Ill.		1,600		Primary	Sat.	Sat.	1,100	None	
Keokuk, Iowa		15,000		None	--	--	Undet.	New Plant	Undetermined
Warsaw, Ill.		1,900	1,900	None	--	--	1,900	New Plant	Undetermined
POPE CREEK, PIKE RUN CREEK:									
Aledo, Ill.		2,600		Secondary	Sat.	Sat.	260	None	
HAWKEYE CREEK:									
Mediapolis, Iowa		600	675	None	--	--	675	New Plant	Undetermined

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

**Includes industrial wastes discharged into municipal sewerage systems.

TABLE I (Cont'd)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Water-courses**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
HENDERSON RIVER, MIDDLE HENDERSON CR.:									
Alexis, Ill.		900		Secondary	Sat.	Sat.	90	None	
CEDAR CREEK:									
Galesburg, Ill.		28,900		Secondary	Sat.	Sat.	290	None	
Monmouth, Ill.		9,100		Secondary	Sat.	Sat.	910	None	
FLINT RIVER:									
Middletown, Iowa		200		Secondary	Sat.	Sat.	50	None	
SKUNK RIVER:									
Williams, Iowa		400	600	Secondary	Unsat.	Sat.	200	Replacement	Undetermined
Ellsworth, Iowa		350	550	None	--	--	550	New Plant	Undetermined
Jewell, Iowa		700		Secondary	Unsat.	Sat.	200	Replacement	Undetermined
Story City, Iowa		1,100		Secondary	Unsat.	Sat.	300	Replacement	Undetermined
Roland, Iowa		500		Secondary	Unsat.	Unsat.	250	Additions	Undetermined
Colfax, Iowa		1,600	1,600	None	--	--	1,600	New Plant	Undetermined
Baxter, Iowa		350		Secondary	Unsat.	Unsat.	300	Replacement	Undetermined
Newton, Iowa									
Northwest Plant		1,100	1,100	Secondary	Unsat.	Sat.	300	Enlargement	Active Planning
South Plant		5,000	6,000	Secondary	Sat.	Sat.	1,500	Enlargement	Under Construction
Southwest Plant		3,000	5,500	Secondary	Unsat.	Sat.	800	Enlargement	Active Planning
Monroe, Iowa		1,000		Secondary	Sat.	Sat.	250	None	

TABLE 1 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Water-courses**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
SKUNK RIVER (Cont'd.)									
Pella, Iowa Main Plant		3,500		Secondary	Sat.	Sat.	800	None	
Newton, Iowa East Plant		2,800		Secondary	Unsat.	Sat.	700	None	To Be Abandoned
University Park, Iowa		350		Primary	Unsat.	Unsat.	200	Replacement	Undetermined
Oskaloosa, Iowa Northeast Plant		6,500		Secondary	Unsat.	Sat.	1,800	Additions	Active Planning
Keota, Iowa		800		Secondary	Unsat.	Sat.	300	Replacement	Undetermined
Brighton, Iowa		500		Secondary	Unsat.	Sat.	200	Additions	Undetermined
Mt. Pleasant, Iowa		3,000		Secondary	Unsat.	Sat.	1,000	Additions	Undetermined
State Hospital		1,700		Secondary	Unsat.	Sat.	500	Enlargement	Undetermined
Danville, Iowa		400		Secondary	Sat.	Sat.	30	None	
SQUAW CREEK:									
Stanhope, Iowa		375		Secondary	Unsat.	Sat.	100	None	
Ames, Iowa		22,000		Secondary	Sat.	Sat.	Undetermined	None	
INDIAN CREEK:									
Nevada, Iowa		3,000		Secondary	Unsat.	Sat.	700	Enlargement	Undetermined
NORTH SKUNK RIVER:									
Melbourne, Iowa		300		Secondary	Sat.	Sat.	50	None	
Grinnell, Iowa		6,000		Secondary	Sat.	Sat.	1,500	None	

TABLE 1 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Watercourses**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
NORTH SKUNK RIVER (Cont'd)									
New Sharon, Iowa		800		Secondary	Unsat.	Sat.	300	Replacement	Preliminary Report
Montezuma, Iowa		1,200	1,400	Secondary	Unsat.	Sat.	600	Replacement	Preliminary Report
What Cheer, Iowa		800		Secondary	Sat.	Unsat.	400	None	
Sigourney, Iowa									
East Plant		900		Secondary	Sat.	Unsat.	400	Additions	Undetermined
West Plant		900		Secondary	Sat.	Unsat.	400	Additions	Undetermined
CROOKED CREEK:									
Washington, Iowa		5,500		Secondary	Unsat.	Sat.	1,000	Enlargement	Undetermined
Winfield, Iowa		600	2,000	Secondary	Unsat.	Sat.	1,500	Replacement	Undetermined
CEDAR CREEK:									
Fairfield, Iowa		6,500		Secondary	Sat.	Unsat.	2,000	None	
BIG SUGAR RIVER, DEVILS CREEK:									
West Point, Iowa		500		Secondary	Sat.	Sat.	100	None	
DES MOINES RIVER:									
Fort Dodge, Iowa		24,000	115,000	Secondary	Unsat.	Sat.	12,000	Enlargement	Final Plans Approved
Lehigh, Iowa		400	400	None	--	--	400	New Plant	Undetermined
Stratford, Iowa		500		Secondary	Unsat.	Sat.	300	Additions	Undetermined
Dayton, Iowa		700		Secondary	Unsat.	Sat.	450	Replacement	Undetermined
Boone, Iowa		11,000		Secondary	Unsat.	Sat.	3,300	Enlargement	Final Plans Approved

TABLE 1 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Watercourse**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
DES MOINES RIVER (Cont'd.)									
Woodward, Iowa State Hospital		2,700		Secondary	Sat.	Sat.	700	None	
Madrid, Iowa		1,700		Secondary	Unsat.	Sat.	400	Additions	Undetermined
Des Moines, Iowa		150,000	300,000	Secondary	Uncat.	Sat.	50,000	Additions	Final Plans Approved
Pleasantville, Iowa		400		Secondary	Sat.	Sat.	100	None	
Pella, Iowa South Plant		200		Secondary	Sat.	Sat.	50	None	
Melcher, Iowa		175		Secondary	Sat.	Unsat.	100	None	
Oskaloosa, Iowa South Plant		6,500		Secondary	Unsat.	Sat.	1,900	Additions	Active Planning
Albia, Iowa									
North Plant		2,000		Secondary	Unsat.	Unsat.	1,200	Additions	Undetermined
Southeast Plant		1,000		Secondary	Sat.	Sat.	250	None	
Ottumwa, Iowa		30,000	330,000	None	--	--	330,000	New Plant	Active Planning
Eldon, Iowa		800	800	None	--	--	800	New Plant	Undetermined
Keosauqua, Iowa		800	1,000	None	--	--	1,000	New Plant	Undetermined
Farmington, Iowa		300	700	None	--	--	700	New Plant	Undetermined
Donnellson, Iowa		400		Secondary	Sat.	Sat.	100	None	
WEST FORK DES MOINES RIVER:									
Currie, Minn.		460		None	--	--	Undetermined	New Plant	Undetermined
Windom, Minn.		2,500		Secondary	Sat.	Sat.	Undetermined	None	

TABLE 1 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Water-course**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
WEST FORK DES MOINES RIVER (Cont'd.)									
Jackson, Minn.		2,500		None	--	--	Undetermined	New Plant	Active Planning
Estherville, Iowa		6,000		Secondary	Sat.	Sat.	5,000	None	
Graettinger, Iowa		600	1,200	None	--	--	1,200	New Plant	Undetermined
Emmetsburg, Iowa		3,300		Secondary	Sat.	Sat.	750	None	
West Bend, Iowa		500		Secondary	Sat.	Sat.	100	None	
Rolfe, Iowa		800		Secondary	Unsat.	Sat.	200	None	
Humboldt, Iowa		2,000		Secondary	Sat.	Sat.	600	None	
BEAVER CREEK:									
Lake Wilson, Minn.		380		None	--	--	Undetermined	New Plant	Undetermined
Slayton, Minn.		1,400		Primary	Unsat.	Undet.	Undetermined	Additions	Undetermined
HERON LAKE OUTLET:									
Lakefield, Minn.		1,500		Secondary	Sat.	Unsat.	Undetermined	None	
Heron Lake Village, Minn.		760		None	--	--	Undetermined	New Plant	Undetermined
OKABENA CREEK:									
Worthington, Minn.		5,300		Secondary	Unsat.	Sat.	Undetermined	Additions	Undetermined
Southwest Minn. Sanatorium		55		Primary	Unsat.	Unsat.	Undetermined	Replacement (Connect to municipal sewer)	Final Plans Approved

TABLE 1 (Cont'd)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Watercourse**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
JACK CREEK:									
Wilmont, Minn.		320		None	--	--	Undetermined	New Plant	Undetermined
EAST FORK DES MOINES RIVER:									
Sherburn, Minn.		950		Primary	Unsat.	Undet.	Undetermined	Additions	Undetermined
Armstrong, Iowa		700	900	None	--	--	900	New Plant	Undetermined
Burt, Iowa		400	550	Secondary	Unsat.	Unsat.	250	Additions	Undetermined
Algona, Iowa		5,000	6,000	None	--	--	6,000	New Plant	Final Plans Approved
MUD CREEK:									
Swea City, Iowa		700	850	Secondary	Unsat.	Unsat.	550	Replacement	Final Plans Approved
Bancroft, Iowa		800	1,000	Intermediate	Unsat.	Unsat.	400	Additions	Undetermined
LOTTS CREEK:									
Bode, Iowa		[illegible]		Secondary	Unsat.	Sat.	250	Additions	Undetermined
Livermore, Iowa		500		Secondary	Sat.	Sat.	120	None	
LIZARD CREEK:									
Pocahontas, Iowa		1,600		Secondary	Sat.	Sat.	400	None	
Gilmore City, Iowa		700		Secondary	Unsat.	Sat.	200	Enlargement	Preliminary Report
BOONE RIVER:									
Corwith, Iowa		360		Secondary	Unsat.	Unsat.	120	Enlargement	Undetermined
Eagle Grove, Iowa		3,500	4,000	None	--	--	4,000	New Plant	Active Planning
Webster City, Iowa		6,000	7,000	Secondary	Sat.	Sat.	2,000	None	

TABLE 1 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Watercourse**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
OTTER CREEK:									
Britt, Iowa		1,500		Secondary	Sat.	Sat.	400	None	
Kanawha, Iowa		500		Secondary	Unsat.	Unsat.	200	Additions	Undetermined
WHITE FOX CREEK:									
Clarion, Iowa		2,500		Secondary	Sat.	Sat.	750	None	
BEAVER CREEK:									
Grand Junction, Iowa		1,000		Secondary	Sat.	Sat.	250	None	
Ogden, Iowa		1,100		Secondary	Unsat.	Sat.	250	Additions	Undetermined
RACCOON RIVER:									
Albert City, Iowa		600		Secondary	Sat.	Sat.	150	None	
Storm Lake, Iowa		6,000	55,000	Secondary	Sat.	Sat.	Undetermined	None	
Sac City, Iowa		2,700		Secondary	Sat.	Sat.	500	None	
Newell, Iowa		800		Secondary	Unsat.	Sat.	200	Enlargement	Undetermined
Lake View, Iowa		1,100		Secondary	Sat.	Sat.	200	None	
Breda, Iowa		450		Secondary	Sat.	Sat.	100	None	
Scranton, Iowa		800		Secondary	Sat.	Sat.	250	None	
Jefferson, Iowa		3,500		Secondary	Sat.	Sat.	1,000	None	
Churdan, Iowa		500		Secondary	Unsat.	Sat.	300	Replacement	Undetermined
Rippey, Iowa		300	300	None	--	--	300	New Plant	Undetermined

TABLE 1 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Watercourse**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
RACCOON RIVER (Cont'd.)									
Perry, Iowa		5,500		Secondary	Unsat.	Sat.	1,000	Additions	Undetermined
Adel, Iowa		1,200	1,200	None	--	--	1,200	New Plant	Undetermined
Dallas Center, Iowa		800		Secondary	Sat.	Sat.	300	None	
CEDAR CREEK:									
Laurens, Iowa		700	1,000	Secondary	Unsat.	Sat.	400	Replacement	Undetermined
Fonda, Iowa		900		Secondary	Unsat.	Unsat.	300	Replacement	Undetermined
LAKE CREEK:									
Pomeroy, Iowa		700		Secondary	Unsat.	Unsat.	500	Replacement	Active Planning
Rockwell City, Iowa		2,000	2,300	Secondary	Unsat.	Sat.	600	Enlargement	Undetermined
Women's Reformatory		88	88	Secondary	Sat.	Undet.	Undet.	Additions	Undetermined
Lake City, Iowa North Plant		1,200		Secondary	Unsat.	Sat.	600	Enlargement	Undetermined
West Plant		500		Secondary	Sat.	Sat.	150	None	
CEDAR CREEK:									
Manson, Iowa		1,400		Secondary	Unsat.	Sat.	500	Additions	Under Construction
Lohrville, Iowa		650		Intermediate	Unsat.	Sat.	400	Replacement	Active Planning
BUTTRICK CREEK:									
Gowrie, Iowa		800	2,000	None	--	--	2,000	New Plant	Final Plans Approved

TABLE 1 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Water-course**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
MIDDLE RACCOON RIVER:									
Carroll, Iowa		6,000		Secondary	Sat.	Sat.	1,000	None	
Glidden, Iowa		800		Secondary	Sat.	Undet.	Undet.	None	
Coon Rapids, Iowa		1,500		Secondary	Sat.	Sat.	250	None	
Panora, Iowa		800	800	None	--	--	800	New Plant	Undetermined
Bagley, Iowa		160		Primary	Unsat.	Unsat.	160	Replacement	Undetermined
Redfield, Iowa		600	600	None	--	--	600	New Plant	Undetermined
Earlham, Iowa		600		Secondary	Unsat.	Sat.	200	Additions	Undetermined
SOUTH RACCOON RIVER:									
Guthrie Center, Iowa		2,000		Secondary	Sat.	Sat.	500	None	
Stuart, Iowa		1,200		Secondary	Unsat.	Sat.	800	Replacement	Undetermined
FOUR MILE CREEK:									
Ankeny, Iowa		1,200		Secondary	Sat.	Sat.	300	None	
NORTH RIVER:									
Dexter, Iowa		400		Secondary	Sat.	Unsat.	200	None	
MIDDLE RIVER:									
Winterset, Iowa		2,400		Secondary	Unsat.	Unsat.	1,000	Enlargement	Undetermined
Indianola, Iowa North Plant		3,000		Secondary	Unsat.	Sat.	800	Replacement	Under Construction (Combined with South Plant

TABLE 1 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Population Served by Sewers	Estimated P.E. (B.O.D.) Untreated Wastes**	Waste Treatment Provided	Adequacy of Treatment Facilities		Estimated P.E. (B.O.D.) Disch'd. to Watercourse**	Treatment Needs	Current Status Municipal* Action
					Cap'y.	Opr.			
SOUTH RIVER:									
Indianola, Iowa									
South Plant		1,000		Secondary	Unsat.	Sat.	450	Replacement	Under Construction (Combined with North Plant)
CAMP CREEK:									
Mitchellville, Iowa									
School for Girls		230		Intermediate	Sat.	Sat.	70	None	
WHITE BREAST CREEK:									
Osceola, Iowa		3,000		Secondary	Sat.	Sat.	600	None	
Chariton, Iowa									
Northwest Plant		1,000		Intermediate	Unsat.	Sat.	600	Replacement	Final Plans Approved
Northeast Plant		700		Intermediate	Unsat.	Sat.	300	Replacement	Final Plans Approved
Southeast Plant		1,200		Intermediate	Unsat.	Sat.	600	Replacement	Final Plans Approved
Knoxville, Iowa		5,000		Secondary	Sat.	Sat.	1,000	None	
Vet. Hospital		2,000		Secondary	Sat.	Sat.	400	None	
CEDAR CREEK:									
Albia, Iowa									
Southwest Plant		500		Secondary	Sat.	Sat.	100	None	

TABLE 2

BASIC DATA ON SOURCES OF INDUSTRIAL* POLLUTION

MISSISSIPPI-DES MOINES-SKUNK RIVERS BASIN

Name and Location	Miles Above Stream Mouth	Type Industry	Type Waste Produced	Treatment or Other Pollution Control Measures:			P.E. (B.O.D.) Disch'd. to Watercourse	Pollution Abatement Needs	Current Status Industrial* Action
				Degree	Adequacy				
					Cap'y.	Opr.			
MISSISSIPPI RIVER:									
Burlington, Iowa									
Iowa Ordnance Plant		Fab. Metals	Organic	None	--	--	Undet.	New Plant	Undetermined
Fort Madison, Iowa									
Paper Mill		Paper	Organic	None	--	--	100,000	New Plant	Undetermined
Keokuk, Iowa									
Corn products		Food	Organic	None	--	--	Undet.	Undet.	Undetermined
Electro metals		Fab. Metals	Inorganic	None	--	--	Undet.	Undet.	Undetermined
SKUNK RIVER:									
Roland, Iowa									
Rendering Plant		Chemical	Organic	None	--	--	Undet.	Undet.	Inactive
Cannery		Food	Organic	Primary	Sat.	Sat.	None	None	
Cambridge, Iowa									
Rendering Plant		Chemical	Organic	None	--	--	Undet.	Undet.	Inactive
Cannery		Food	Organic	Primary	Sat.	Sat.	None	None	
BRUSH CREEK:									
Lockridge, Iowa									
Insecticide Plant		Chemical	Organic and inorganic	Undet.	--	--	Undet.	Undet.	Active Planning
CEDAR CREEK:									
Fairfield, Iowa									
Soybean Plant		Chemical	Organic	Undet.	--	--	Undet.	Undet.	Inactive

*Industries having separate outlets and discharging wastes directly to watercourse.

TABLE 2 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Type Industry	Type Waste Produced	Treatment or Other Pollution Control Measures: Degree	Adequacy: Cap'y.	Adequacy: Opr.	P.E. (B.O.D.) Disch'd. to Watercourse	Pollution Abatement Needs	Current Status Industrial* Action
DES MOINES RIVER:									
Des Moines, Iowa John Deere Des Moines Works		Fab. Metals	Organic	Secondary	Sat.	Sat.	250	None	
Albia, Iowa Rendering Plant		Chemical	Organic	Primary	Unsat.	Unsat.	Undet.	Replacement	Final Plans Approved
WEST DES MOINES RIVER:									
Estherville, Iowa Rendering Plant		Chemical	Organic	Primary	Unsat.	Unsat.	Undet.	Replacement	Active Planning
Wallingford, Iowa Creamery		Food	Organic	None	--	--	400	New Plant	Inactive
OKABENA CREEK:									
Worthington, Minnesota Rendering Co.		Chemical	Organic	Secondary	Unsat.	Unsat.	Undet.	Enlargement	Under Const.
EAST DES MOINES RIVER:									
Algona, Iowa Rendering Plant		Chemical	Organic	None	--	--	Undet.	Undet.	Undetermined
OTTER CREEK:									
Kanawaha, Iowa Creamery		Food	Organic	None	--	--	300	New Plant	Inactive
Eagle Grove, Iowa Coop. Rendering Plant		Chemical	Organic	Secondary	Sat.	Sat.	100	None	
BEAVER CREEK:									
Perry, Iowa Arnold Packing Co.		Food	Organic	Primary	Sat.	Undet.	15,000	New Plant	Undetermined

TABLE 2 (Cont'd.)

Name and Location	Miles Above Stream Mouth	Type Industry	Type Waste Produced	Treatment or Other Pollution Control Measures:			P.E. (B.O.D.) Disch'd. to Water-course	Pollution Abatement Needs	Current Status Industrial* Action
				Degree	Adequacy				
					Cap'y.	Opr.			
RACCOON RIVER:									
Storm Lake, Iowa Cannery		Food	Organic	Undet.	--	--	Undet.	None	
Lytton, Iowa Creamery		Food	Organic	Secondary	Sat.	Undet.	Undet.	None	
LAKE CREEK:									
Lake City, Iowa Rendering Plant		Chemical	Organic	Primary	Unsat.	Unsat.	200	Replacement	Undetermined
BUTTRICK CREEK:									
Gowrie, Iowa Creamery		Food	Organic	None	--	--	3,000	New Plant	Undetermined
MIDDLE RACCOON RIVER:									
Redfield, Iowa Soybean Processing Plant		Chemical	Organic	None	--	--	400	New Plant	Active Planning
FOUR MILE CREEK:									
Slater, Iowa Creamery		Food	Organic	None	--	--	3,000	New Plant	Undetermined

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